Standard Reference Materials for Hexavalent Chromium in Contaminated Soil

NIST, in cooperation with the New Jersey Department of Environmental Protection (NJDEP), and the U.S. Environmental Protection Agency (EPA), is developing a Standard Reference Material (SRM) to provide traceability for measurements of hexavalent chromium in soil and contaminated waste to help remediate waste sites throughout the country. A suitable collection site has been identified and the material processed for production of the SRM.

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During the last century, chromate chemical production facilities processed considerable quantities of chromite ore for industrial manufacturing. The waste material from these operations, known as chromite ore processing residue (COPR,) ended up in waste sites across the country, and as fill material for building foundations, road construction, and other civil engineering applications. In New Jersey alone, over 160 waste sites have been identified that are contaminated with COPR. This waste material consists of a mixture of chromite and chromate, otherwise known as hexavalent chromium, which is now widely recognized as a human carcinogen. To remediate these sites, there is a need to make high-quality chemical measurements of the hexavalent chromium in waste samples.

The environmental community, including those responsible for promulgating analytical methods, developing policy, enforcing regulations, and interpreting laboratory data, has long known that transition metal chemistry in non-aqueous media involves the actual species present, and not just the total elemental composition. The risk to humans is often dependent upon the form of the metal in the soil or sediment. Chromium (Cr) in the environment exists in two principal oxidation states – Cr-III, a micronutrient, and Cr-VI, a known carcinogen. In the presence of inorganic and/or organic matrix components such as sulfide, iron, manganese, and organic carbon, the two species can interconvert from one form to the other. The use of some analytical methods is also known to alter the species distribution, thereby compromising test data designed to evaluate risk assessment. Species-based environmental regulation is now a reality despite the uncertainties in the underpinning measurement science. There is therefore a need for a high-quality reference material to improve the quality of these measurements.

To respond to this need, NIST has worked jointly with NJDEP and the EPA to collect and prepare SRM 2701 Hexavalent Chromium in Contaminated Soil. This material, a soil contaminated with COPR, was collected from a waste site in New Jersey and was milled, blended, radiation sterilized, and bottled into 80 g units by the United States Geological Survey (USGS) in Colorado. The material is now undergoing a six-month stability assessment study by a group of eight expert laboratories using approved analytical methods. If it is demonstrated that the material has acceptable stability, certification measurements will commence at NIST. The intention is to provide certified values for both total chromium and hexavalent chromium and other species of interest such as mercury. Additional reference measurements are planned for other critical components including sulfide, manganese, iron, and total organic carbon. The properties of the SRM (pH and eH) will also be characterized to provide the user with additional stability mapping information.

Impact: Hexavalent chromium litigation and waste-site remediation activities are now common, with an associated need for high-quality chemical information on the chromium species present. The use of this new SRM material will provide traceability for environmental measurements in compliance with national regulations.

Future Plans: The remaining material collected from the site will be used to generate additional QC materials for use by the EPA. This will considerably enhance the effectiveness of the EPA-approved test methods for hexavalent chromium. The QC materials will be prepared by custom blending SRM 2701 stock material gravimetrically with quartz sand to produce traceable mixtures of known hexavalent chromium concentration and uncertainty.